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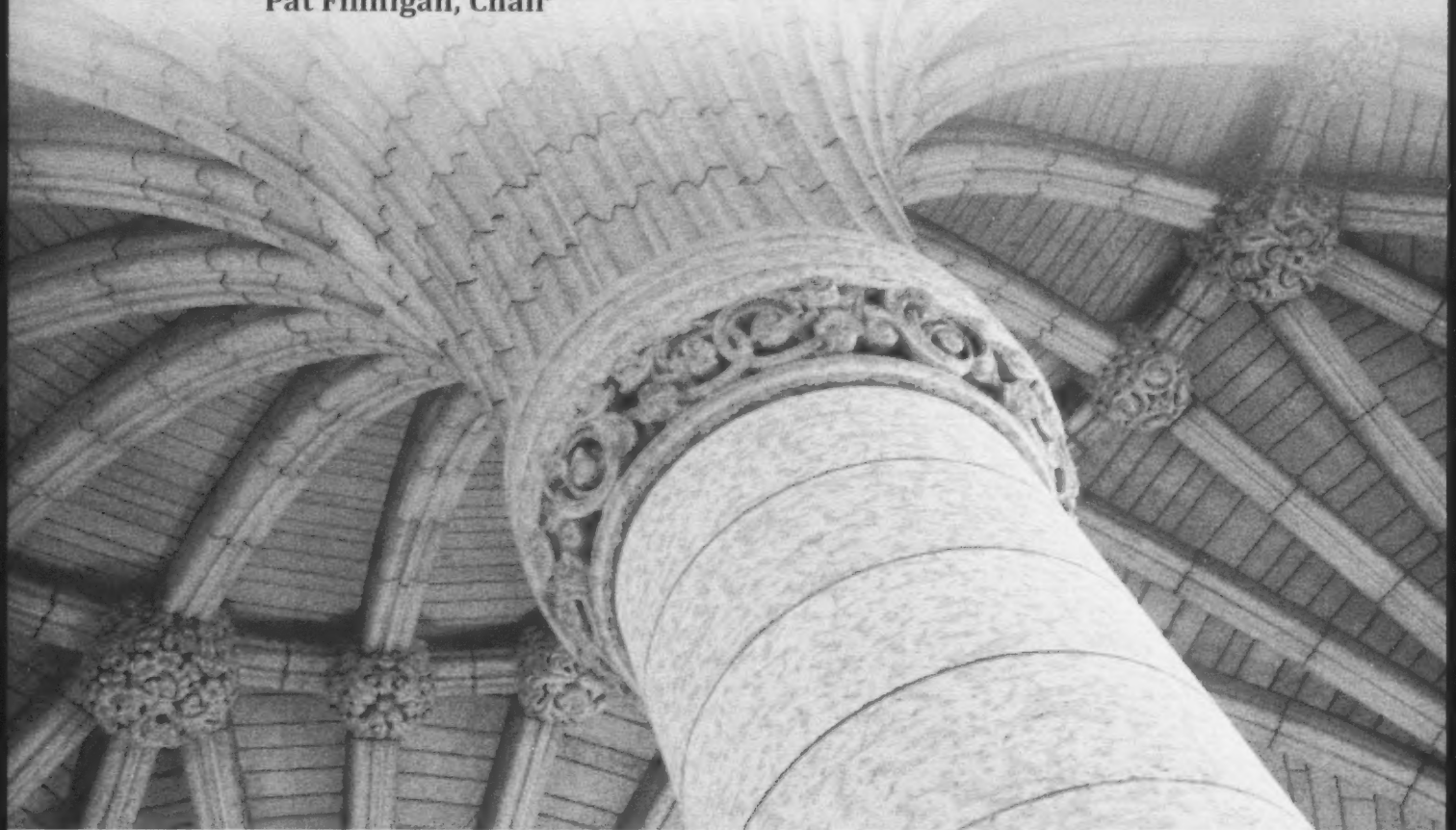
CANADA

TOWARD A RESILIENT CANADIAN AGRICULTURE AND AGRI-FOOD SYSTEM: ADAPTING TO CLIMATE CHANGE

Report of the Standing Committee on Agriculture and Agri-Food

Pat Finnigan, Chair



MAY 2018
42nd PARLIAMENT, 1st SESSION

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Pat Finnigan
Chair

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NOTICE TO READER

Reports from committee presented to the House of Commons

Presenting a report to the House is the way a committee makes public its findings and recommendations on a particular topic. Substantive reports on a subject-matter study usually contain a synopsis of the testimony heard, the recommendations made by the committee, as well as the reasons for those recommendations.

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THE STANDING COMMITTEE ON AGRICULTURE AND AGRI-FOOD

has the honour to present its

ELEVENTH REPORT

Pursuant to its mandate under Standing Order 108(2), the Committee has studied Climate Change and Water and Soil Conservation Issues and has agreed to report the following:

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SUMMARY

From November 7, 2017 to February 7, 2018, the House of Commons Standing Committee on Agriculture and Agri-Food conducted a study on climate change adaptation and water and soil conservation issues.

The Committee heard from witnesses that they are already experiencing the impacts of climate change. The report describes these impacts, such as changing weather patterns and more extreme weather events. It also describes anticipated future impacts of climate change on Canadian agriculture, including the expanded distribution of pests and diseases. In addition, the report outlines Canada's efforts to reduce greenhouse gas emissions, which affect farmers because they need to adapt their practices to remain competitive while continuing to reduce emissions. It also outlines the policy frameworks that relate to climate change adaptation in Canada broadly and agriculture specifically. The Committee heard from witnesses about the challenges of protecting soil and water resources in the context of climate change, and the report outlines challenges and solutions in both of these areas.

The report outlines ways the government could pro-actively address challenges associated with adapting to climate change, while helping the agriculture and agri-food industry stay competitive and grow as planned: Investing in innovation and research; better mapping Canada's soils; and supporting research related to strengthening the environmental sustainability of the sector, among others.

The report highlights steps the government could take to position Canadian farmers to be world leaders in sustainable agriculture, and to help Canada's agriculture and agri-food sector build resilience to climate change. The Committee's recommendations include incentivizing climate-resilient agricultural practices and disseminating information about them; closing the gap between researchers and producers through extension, and developing business risk management programs that support producers' innovative efforts to adapt to climate change.

Given agricultural producers' long history of successful adaptation, the Committee believes that with government support for research, innovation, and building public trust, Canadian agricultural producers will continue to build a climate-resilient future.

LIST OF RECOMMENDATIONS

As a result of their deliberations, committees may make recommendations which they include in their reports for the consideration of the House of Commons or the Government. Recommendations related to this study are listed below.

Recommendation 1

The Committee recommends that the Government of Canada, in collaboration with the provinces, conduct an in-depth analysis of the status of Canada's soils to measure compaction, degradation, element composition, and other important qualifying factors as well as an analysis to quantify the economic benefit of soil carbon sequestration. **17**

Recommendation 2

The Committee recommends that the Government of Canada examine quantitative water management techniques and invest in appropriate infrastructure initiatives to accommodate water excesses and deficits that meet the varying and unique geographic needs across Canada. **20**

Recommendation 3

The Committee recommends that the Government of Canada create incentives for farmers to adopt integrated watershed management and land use systems to improve downstream water quality in the interest of the public good. **20**

Recommendation 4

The Committee recommends that the Government of Canada take into account the realities of the agriculture and agri-food sector when implementing greenhouse gas emissions reduction measures in order to avoid making the sector less competitive. **23**

Recommendation 5

The Committee recommends that the Government of Canada continue supporting science, research and innovation in order to implement measures that are tailored to the local priorities of the agriculture sector, with the goal of strengthening its environmental sustainability. **26**

Recommendation 6

The Committee recommends that the Government of Canada work with the Pest Management Regulatory Agency and industry to mitigate adverse effects on producers and the environment that may result from banning pesticides without establishing clear alternative solutions. 33

Recommendation 7

The Committee recommends that Agriculture and Agri-Food Canada continue to support research into livestock production in order to improve animal genetics and diet with the goal of reducing greenhouse gas emissions. 35

Recommendation 8

The Committee recommends that the Government of Canada improve the approval process for new crop varieties in order to help farmers adapt to climate change quickly and seize commercialization opportunities while staying competitive in the market. 36

Recommendation 9

The Committee recommends that the Government of Canada increase investment in research and innovation in ecological and organic agriculture to better reflect that sector's growing proportion of the market, recognizing that this may yield benefits for agriculture in general. 37

Recommendation 10

The Committee recommends that the Government of Canada provide full funding for the Organic Standards review beginning in March 2018. 38

Recommendation 11

The Committee recommends that the Government of Canada support agroforestry as a way to increase soil carbon sequestration potential for Canada. 40

Recommendation 12

The Committee recommends that the Government of Canada support agricultural producers and processors in Canada by adopting policies and trade agreements that protect our producers and processors from economies that may not have the same environmentally rigorous standards as Canada. 40

Recommendation 13

The Committee recommends that climate change efforts be focused on adaptive measures and mitigation efforts, and providing a positive impact to economy, therefore building on Canada's competitive advantages and maintaining competitiveness for Canadian agricultural products. 41

Recommendation 14

The Committee recommends that the Government of Canada continue to support and allow for extension that complements research activities, in order to help close gaps between researchers and producers. 41

Recommendation 15

The Committee recommends that the Government of Canada continue to support sharing of important information related to environmentally sustainable farming practices and adaptation. 44

Recommendation 16

The Committee recommends that the Government of Canada acknowledge the role that producers play as environmental stewards and the innovative ways they are adapting to climate change, as well as their contribution to the public good, in order to strengthen Canadians' understanding and build public trust. 44

Recommendation 17

The Committee recommends that the Government of Canada encourage new and established farmers to buy into best climate-resilient practices, equipment and technology that will increase agricultural efficiency, long-term resilience and sustainability. 44

Recommendation 18

The Committee recommends that the Government of Canada work in collaboration with the provinces and territories to support greater recognition and measurement of ecosystem services. 45

Recommendation 19

The Committee recommends that the Government of Canada develop business risk management programs that meet the needs of producers of all scales, including diversified producers, and that the government continue to develop risk management support programs that facilitate producers' innovative efforts to adapt to climate change. 45

TOWARD A RESILIENT CANADIAN AGRICULTURE AND AGRI-FOOD SYSTEM: ADAPTING TO CLIMATE CHANGE

INTRODUCTION

The viability of agriculture depends in large part on weather conditions. Climate change poses serious social, economic and environmental challenges for agriculture in Canada. While adapting to change is second nature to farmers, they will have to deal with the impacts of increasingly frequent extreme weather events, as well as changing temperatures and precipitation patterns. They will also need to adjust to the ways society responds to climate change.

To better understand the issues surrounding climate change and to promote sustainable agriculture, the Standing Committee on Agriculture and Agri-Food (the Committee) reviewed the subject and adopted the following motion on Tuesday, 6 December 2016:

> That the Committee undertake a study of how the government can help the Canadian agriculture sector better adjust to the increasing severity of issues associated with climate change and better address water and soil conservation issues and that the Committee report its findings to the House.[1]

The Committee held seven public meetings between 7 November 2017 and 7 February 2018, during which it heard testimony from various stakeholders in the agriculture and agri-food sector, including, for example, farmers, academic researchers and officials from Agriculture and Agri-Food Canada (AAFC).

The members of the Committee would like to extend their sincere thanks to all the witnesses who participated in this study. The Committee is pleased to present the results of its study in this report, along with recommendations based on the evidence it heard.

OVERVIEW OF CLIMATE CHANGE IN CANADA

Many studies have confirmed the existence of global climate change. The 2013 report of the Intergovernmental Panel on Climate Change (IPCC) found, globally, higher

1 House of Commons, Standing Committee on Agriculture and Agri-Food, *Minutes of Proceedings*, 1st Session, 42nd Parliament, 6 December 2016.

atmospheric and ocean temperatures, reduced amounts of snow and ice, a higher sea level, greater greenhouse gas concentrations and more frequent extreme weather events.[2]

The witnesses the Committee heard unanimously reported that climate change is quite real and apparent in Canada. Their experience reflected the findings of the IPCC report, as they have in recent years seen longer growing seasons, more intense periods of precipitation and drought, increasingly frequent extreme weather events and a small increase in the frost-free period.

A. Observed Weather Events

Environment and Climate Change Canada measurements have shown an increase in average annual temperatures across Canada. Data show that temperatures in Canada have been climbing gradually since the 1940s. Annual temperatures fluctuated from year to year in the period from 1948 to 2016, but the linear trend shows that annual temperatures, averaged across the nation, increased by 1.7°C over that period.[3] Over the past 70 years, summer temperatures, averaged across the country, have increased by 1.5°C;[4] spring temperatures have increased by 1.7°C.[5] The most notable warming is in winters: Winter temperatures have increased by 3.4°C.[6]

---

2 Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis*, Summary for Policymakers.

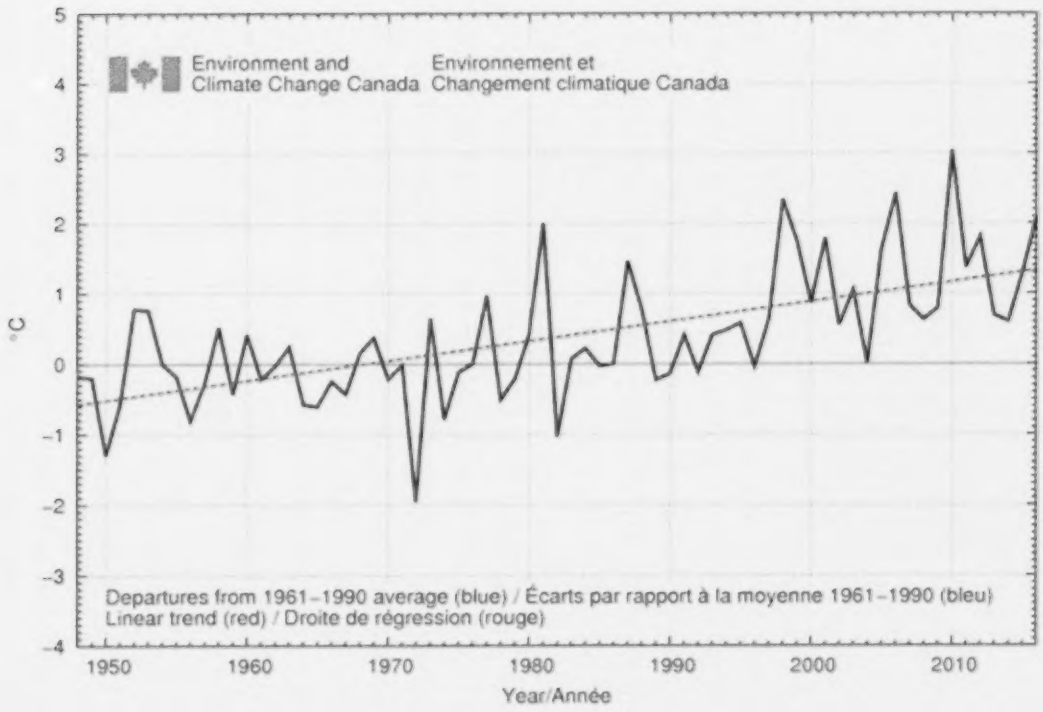
3 Government of Canada, *Annual 2016: Climate Trends and Variations Bulletin*.

4 Government of Canada, *Climate Trends and Variations Bulletin: Summer 2017*.

5 Government of Canada, *Climate Trends and Variations Bulletin: Spring 2017*.

6 Government of Canada, *Climate Trends and Variations Bulletin: Winter 2016/2017*.

Figure 1 – Annual national temperature departures and long-term trend, 1948-2016

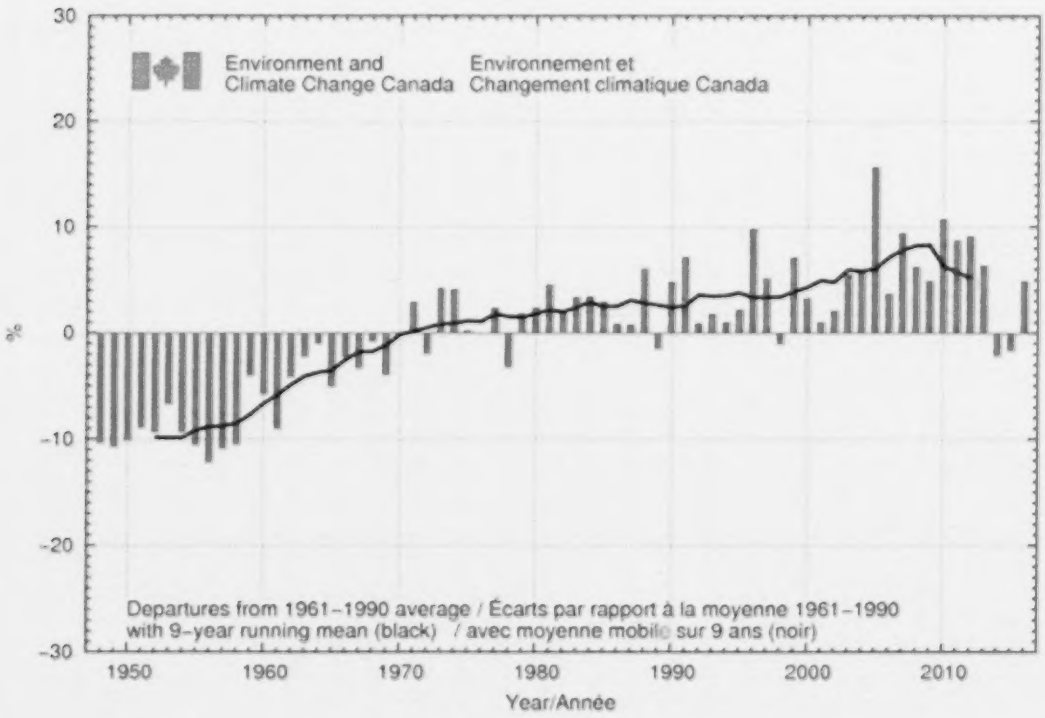


Source: Government of Canada, Annual 2016: Climate Trends and Variations Bulletin.

Precipitation patterns are also changing in Canada. According to data from Environment and Climate Change Canada, annual precipitation amounts, averaged across the nation, have been increasing compared with the 1961-1990 average since the beginning of the 1970s.[7]

7 Source: Government of Canada, Annual 2016: Climate Trends and Variations Bulletin.

Figure 2 – Annual national precipitation departures with nine-year running mean, 1948-2016



Source: Government of Canada, Annual 2016: Climate Trends and Variations Bulletin.

B. Contributions to Climate Change by Economic Sector

Greenhouse gas (GHG) emissions generated by agricultural activity come in three main forms: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).[8] Globally, agriculture emits between 10% and 15% of total GHG emissions. In Canada, the agriculture sector is responsible for about 10% of GHG emissions.[9] These come primarily from crop and livestock production and do not include emissions from fossil fuel-powered agricultural equipment:[10]

8 Agriculture and Agri-Food Canada, "Greenhouse gases."

9 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1530 (Brian Gray, Assistant Deputy Minister, Science and Technology Branch, Agriculture and Agri-Food Canada).

10 Environment and Climate Change Canada, *Greenhouse Gas Sources and Sinks – Executive Summary*, 2017.

> Overall, animals, such as cows, are responsible for about 40% of Canada's [agricultural] greenhouse gases when CO2 or the equivalent[11] is used. Manure is responsible for about 10% to 15% of [agricultural] greenhouse gases. The N2O from soil is also responsible for about 40% of [these] gases. Managing N2O in the soil is therefore a major challenge for conservation.[12]

During the government's consultations on the development of *A Food Policy for Canada*, food waste and the resulting GHG emissions were identified as a priority for that policy. Agriculture and Agri-Food Canada estimates that food waste is the source of about 3% of total Canadian GHG emissions.[13] These emissions are not included in estimated GHG emissions from agriculture.[14]

In 2015, Canada emitted a total of 722 megatonnes of carbon dioxide equivalent (CO_2 eq). The oil and gas sector and the transportation sector were among the largest emitters of GHGs, at 26% and 24% of Canada's total emissions, respectively. The buildings and electricity sectors accounted for 12% and 11% of emissions, respectively. Heavy industry and agriculture were each responsible for 10% of total GHG emissions, while waste and others contributed 7% of all GHG emissions (see Figure 3).[15] In 2015, Canada's agriculture sector produced 28% of the country's CH_4 emissions and 71% of its N_2O emissions.[16]

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11 "Greenhouse gas emissions are reported in carbon dioxide equivalents (CO_2 eq), determined by multiplying the amount of emissions of a particular gas by the global warming potential of that gas. Greenhouse gases differ in their ability to absorb heat in the atmosphere due to their differing chemical properties and atmospheric lifetimes."

12 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1600 (Brian Gray).

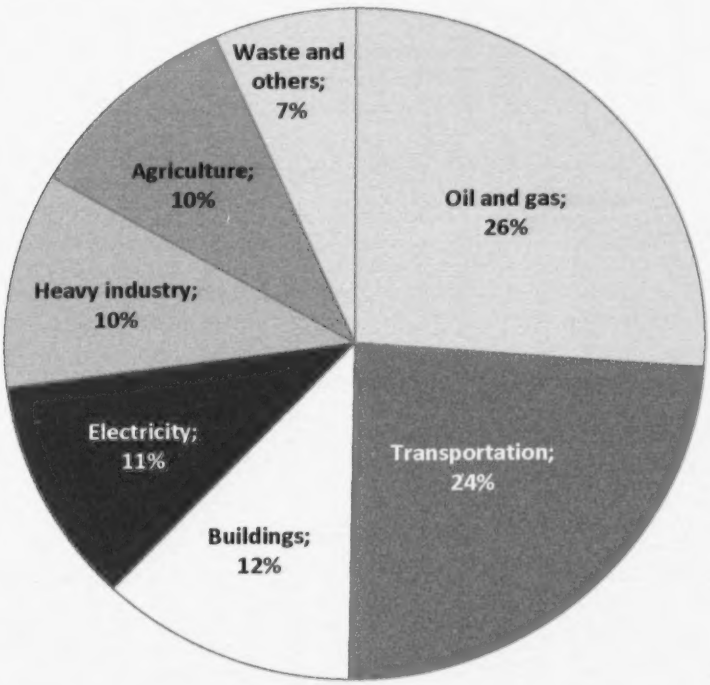
13 Ibid., 1545 (Tom Rosser, Assistant Deputy Minister, Strategic Policy Branch, Agriculture and Agri-Food Canada).

14 Environment and Climate Change Canada, *Greenhouse Gas Sources and Sinks – Executive Summary*, 2017.

15 Environment and Climate Change Canada, *Canadian Environmental Sustainability Indicators: Greenhouse Gas Emissions*, 2017.

16 Environment and Climate Change Canada, *Greenhouse Gas Sources and Sinks – Executive Summary*, 2017.

Figure 3 – Greenhouse Gas Emissions by Canadian Economic Sector, 2015



Notes:

a. "Waste and others" includes emissions from light manufacturing, construction, forest resources, waste and coal production.

b. "Heavy industry" includes emissions arising from mining, smelting and refining, pulp and paper, iron and steel, cement, lime and gypsum, and chemicals and fertilizers.

Source: Figure prepared by the Committee using data from Government of Canada, "Greenhouse gas emissions by Canadian economic sector."

C. Agricultural Greenhouse Gas Indicator

Figures 4 and 5 show the total agricultural GHG emissions in kilograms of CO_2 eq per hectare in 2011. The indicator shows net farm emissions, calculated by estimating the amounts emitted and subtracting the amounts absorbed by soil.

For historical and climatic reasons, agricultural production in Canada differs greatly from one region to another. Grain production and beef cattle farming are concentrated on the

Prairies, while dairy, pork and poultry farming, as well as corn and soy production, take place mainly in Eastern Canada. As different types of farming produce different amounts of GHG emissions, these emissions also vary from one region to another.[17]

Canada's western regions have lower GHG emissions per hectare than its eastern regions. The adoption of beneficial practices that help sequester carbon in soil has helped lower GHG emissions. Carbon sequestration can be achieved through agricultural best practices such as reducing or eliminating tillage, moving away from summer fallow and converting from annual crops to perennial cover.[18]

Regions in Eastern Canada have also adopted beneficial management practices. However, these areas still produce relatively large amounts of net GHG emissions per hectare. The conversion from perennial forages to annual crops is part of the reason for the higher GHG emissions, along with the high concentration of crops that require a lot of nitrogen fertilizer, such as corn.[19] Moreover, no-till farming remains relatively rare in Eastern Canada,[20] particularly because it is difficult to achieve with vegetable crops.[21]

While net GHG emissions per hectare vary from one region of Canada to the next, GHG emissions from the agriculture sector as a whole have remained relatively stable over the past 20 years.[22] At the same time, the agriculture sector has made a large contribution to Canada's economic growth. Therefore, the sector's emissions intensity (GHG emissions per dollar of gross domestic product) has declined significantly, showing that Canadian agriculture has become more and more efficient over this period.[23]

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17 Agriculture and Agri-Food Canada, Top commodities by province.

18 Agriculture and Agri-Food Canada, "Agricultural Greenhouse Gas Indicator."

19 Ibid.

20 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1640 (Alan Kruszel, Chair, Soil Conservation Council of Canada).

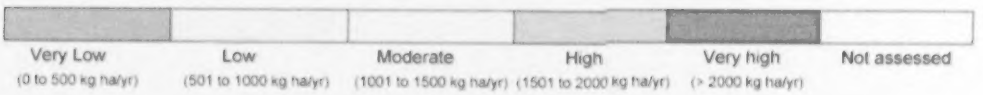
21 Ibid., 1725.

22 Government of Canada, Greenhouse gas emissions by Canadian economic sector.

23 Agriculture and Agri-Food Canada, An Overview of the Canadian Agriculture and Agri-Food System 2016.

Figure 4 – Net Greenhouse Gas Emissions (kilograms of CO_2 equivalent per hectare) Western Canada, 2011

Legend:



Source: Agriculture and Agri-Food Canada, "Agricultural Greenhouse Gas Indicator**."**

Figure 5 – Net Greenhouse Gas Emissions (kilograms of CO_2 equivalent per hectare) Eastern Canada, 2011

Legend:

Very Low	Low	Moderate	High	Very high	Not assessed
(0 to 500 kg ha/yr)	(501 to 1000 kg ha/yr)	(1001 to 1500 kg ha/yr)	(1501 to 2000 kg ha/yr)	(> 2000 kg ha/yr)	

Source: Agriculture and Agri-Food Canada, "Agricultural Greenhouse Gas Indicator."

ISSUES OF WATER AND SOIL CONSERVATION

While agriculture produces GHGs, it has the capacity to capture carbon and therefore reduce its overall GHG emissions, and this is already happening. By continuing to adopt beneficial management practices, producers can continue to improve the environmental performance of agriculture. Many of these practices are related to the management of soil and water resources.

A. Soil: Agriculture's Foundation

The importance of protecting and preserving soil health was recognized by witnesses from a wide range of sectors. According to Alan Kruszel, Chair of the Soil Conservation

Council of Canada, it is important to "promote the health of the soil in order to help us face up to climate change."[24]

Witnesses described numerous ways of reversing soil degradation and building soil health. They agreed that building up soil organic matter is essential to successful agriculture. Tracy Misiewicz, Associate Director of Science Programs at The Organic Centre, encapsulated the interconnected benefits of building soil organic matter:

> Soil organic matter has a positive impact on ... physical, chemical, and biological soil properties. It provides structural stability to the soil, reduces erosion, protects against soil compaction, and improves aeration, water infiltration, and soil water-holding capacity, all key characteristics that will be particularly important in times of drought or flooding. Soil organic matter also serves as a reserve for nutrients essential to plant growth, including nitrogen, phosphorus, and sulphur, and it makes up the base of the soil food web, providing a foundation for all soil life.[25]

Witnesses agreed on the importance of preventing wind and water erosion, and many mentioned the use of zero-till, or no-till, farming, in which farmers eliminate tilling, plant seed and apply fertilizer with minimal soil disturbance, and leave crop residues in the soil, often in conjunction with enhanced crop rotation and the use of intercropping and cover crops. In no-till farming, plant residues left on the land improve soil structure with their roots, help build soil organic matter, store nutrients, and protect the soil against erosion.[26] These soil health improvements may mean that fewer inputs would be needed in the long term. This approach has been promoted and supported strongly by the Saskatchewan Soil Conservation Association.[27]

To deal with wet soils, some producers are experimenting with new drainage systems and trying to prevent soil compaction. Compaction is usually caused by the weight of heavy machinery, especially on wet soil. It limits opportunities for soil microorganisms and macro-fauna, and can cause serious drainage problems for producers.[28]

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24 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1640 (Alan Kruszel, Chair, Soil Conservation Council of Canada).

25 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1535 (Tracy Misiewicz, Associate Director of Science Programs, The Organic Centre, Canada Organic Trade Association).

26 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1540 (Aubert Michaud, Soil and Water Conservation Scientist, Research and Development Institute for the Agri-environment).

27 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1540 (Doyle Wiebe, Director, Grain Growers of Canada).

28 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1540 (Aubert Michaud).

To maintain soil moisture and reduce erosion, witnesses recognized the importance of protecting or replanting shelterbelts and riparian buffers (vegetated areas between farmland and water that stabilize banks, prevent erosion, protect water from runoff pollution, and provide habitat). Some witnesses talked about the benefits of agroforestry, in which trees growing near agricultural land can provide various benefits in addition to building soil carbon.

Many witnesses were aware of the potential for agricultural lands to sequester carbon and were interested in offset protocols or other means of benefitting financially from the ecosystem services[29] they provide to others. Kimberly Cornish of Food Water Wellness Foundation pointed out that carbon offsets could help farmers not only to improve their soil, but also to generate revenue.[30] Sean Smukler, Assistant Professor at the University of British Columbia, noted that "... across Canada, it's possible that we could substantially increase our soil organic matter on the 20% of our agricultural lands that are currently considered moderately to severely degraded and are not currently sequestering carbon."[31]

Alan Kruszel suggested it would be useful to carry out a "national study to reassess the cost and consequences of soil degradation in Canada, with an emphasis on greenhouse gas implications."[32] Some witnesses agreed that an in-depth national analysis of soil health could be helpful to establish a common understanding of needs related to soil conservation.

Recommendation 1

The Committee recommends that the Government of Canada, in collaboration with the provinces, conduct an in-depth analysis of the status of Canada's soils to measure compaction, degradation, element composition, and other important qualifying factors as well as an analysis to quantify the economic benefit of soil carbon sequestration.

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29 According to the Ecosystem Services Toolkit, *"Ecosystem services (ES)* are the result of environmental processes, sometimes with human interventions. ES provide benefits that humans depend on to support life (e.g., because ecosystems produce air, water, and food) security (e.g., by mitigating extreme weather events), and well-being (e.g., by supporting mental and physical health, cultural identity, spirituality, recreation). For analysis purposes, four commonly used categories of ES are: Provisioning ES – result in material goods; Regulating ES – support habitable conditions; Cultural ES – contribute to non-material benefits; Supporting/habitat ES – underpin the other three categories" (p. 10).

30 House of Commons, AGRI, Evidence, 1st Session, 42nd Parliament, 7 February 2018, 1635 (Kimberly Cornish, Executive Director, Food Water Wellness Foundation).

31 House of Commons, AGRI, Evidence, 1st Session, 42nd Parliament, 12 December 2017, 1640 (Sean Smukler, Assistant Professor, Junior Chair of Agriculture and Environment of the University of British Columbia).

32 House of Commons, AGRI, Evidence, 1st Session, 42nd Parliament, 7 November 2017, 1650 (Alan Kruszel).

B. Water: Quality and temporal changes

Witnesses reported a range of challenges related to water availability and quality. In many areas, access to sufficient water – at the right times of year – can no longer be taken for granted. As distribution and timing of water surpluses and deficits change, farmers need to adapt.

Meanwhile, structures built to help to manage water flow were not designed to accommodate the large volumes of runoff now coming in winter and early spring, but only to manage normal peak summer water flows.[33] The Committee heard that new structures to manage water runoff in tiled fields can help farmers save water until it is needed for crop use. In one study, this approach led to increased yields as well as a 60% reduction in nutrient runoff and a 75% reduction in bacteria runoff – thus offering additional environmental benefits.[34]

Stewart Rood described the situation for a typical river in Alberta that drains from the Rocky Mountains:

> Even though we're getting more rain, we're getting more drying from evaporation, but most critically, we have reduced flows late in the summer, in July but especially in August and September. We have a temporal problem in that we have abundant water in the spring, but demand for water for irrigation and other uses happens later in the summer.[35]

Stewart Rood also noted that conditions on the Prairies are becoming dryer as the temperature gets warmer. The shortage of water may eventually lead to a shortage of production capacity. Reduced volume of water is also a problem because "as we lose the water in the river, any contaminants, whether from agricultural, industrial, or municipal sources, become more concentrated. We have this interaction between declining water quantity and degrading water quality. Both are likely to increase with climate change."[36]

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33 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1540 (Aubert Michaud).

34 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1640 (Emilia Craiovan, Agricultural Producer and Chair of the Board of Directors, Union des cultivateurs franco-ontariens).

35 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1640 (Stewart Rood, Professor, University of Lethbridge).

36 Ibid.

Recovery from water shortage is not always fast. According to Andrea Brocklebank, in non-irrigated areas, where the majority of cattle production takes place, the degradation caused by two years of drought can take ten years to recover.[37]

Nutrient management plans can help producers reduce the run-off of nutrients from manure or fertilizer piles into water bodies.[38] According to Hans Kristensen, in some parts of Canada, many producers use an injection method when spreading manure,[39] reducing runoff while at the same time making the nutrient available at the roots where it is needed.

Water runoff from agricultural lands may result in sedimentation and eutrophication in water bodies when soil and nutrients (typically excess phosphorous from manure or mineral fertilizers)[40] run off along with the water. Pesticides, other agricultural chemicals, and pathogens may also be carried to water bodies in run-off.[41] Hotter seasons will increase the opportunity for eutrophying cyanobacteria to grow in water bodies that already suffer from excess nutrients from agricultural run-off.[42]

Whereas soil conservation usually enhances a farmer's own soil, water quality improvements mainly affect downstream water users and not those who undertake them. As Naresh Thevathasan, noted, farmers who do not benefit directly from improving water quality may ask themselves, for example, "why should I put in riparian buffers for somebody downstream to benefit? Will I get a tax credit on my property? What incentive will I get in order for me to invest in public-good land use systems?"[43]

Several witnesses highlighted the interconnectedness of soil and water issues. Aubert Michaud pointed out: "We have to have an overall vision for the integrated management

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37 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1715 (Andrea Brocklebank, Executive Director, Beef Cattle Research Council).

38 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1555 (Ms. Susie Miller, Executive Director, Canadian Roundtable for Sustainable Crops).

39 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1535 (Hans Kristensen, First vice-chair, Canadian Pork Council).

40 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1610 (Aubert Michaud).

41 Agriculture and Agri-Food Canada, *Agriculture and water quality*, 22 August 2014.

42 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1615 (Aubert Michaud).

43 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1600 (Naresh Thevathasan, Associate Professor, School of Environmental Sciences, University of Guelph).

of ... watersheds. The quality of the soil and the water, the performance of the crops and the impact of agricultural activity on water quality downstream are all interrelated."[44]

As producers find ways to manage soil and water resources even better, they will also be adapting to climate change and becoming more resilient. The federal government is already providing producers with tools to help them better adapt to climate change, including various measures under the Pan-Canadian Framework on Clean Growth and Climate Change, business risk management programs and environmental farm plans. These measures and programs are discussed in the next section.

Recommendation 2

The Committee recommends that the Government of Canada examine quantitative water management techniques and invest in appropriate infrastructure initiatives to accommodate water excesses and deficits that meet the varying and unique geographic needs across Canada.

Recommendation 3

The Committee recommends that the Government of Canada create incentives for farmers to adopt integrated watershed management and land use systems to improve downstream water quality in the interest of the public good.

LEGISLATIVE AND POLICY FRAMEWORKS

Agricultural policies and practices have changed over the decades, especially in response to climate-related disasters, including periods of accelerated soil and water degradation.[45] The first Government of Canada programs to address climatic variations date back to the 1930s. Following a prolonged and devastating drought on the Prairies in the 1930s, the government established the Prairie Farm Rehabilitation Administration (PFRA) as a division of AAFC. The PFRA's primary mandate was to rehabilitate Prairie farms that had suffered soil degradation and to foster economically viable agricultural activity.[46]

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44 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1555 (Aubert Michaud).

45 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1630 (David Sauchyn, Professor, Prairie Adaptation Research Collaborative, University of Regina).

46 Ibid., 1700.

> The Prairie Farm Rehabilitation Administration, or PFRA, implemented government programming related to soil and water conservation and rural development in western Canada, and for a few years late in its mandate, right across the country.[47]

The PFRA was particularly effective at researching climate change adaptation and communicating its findings to farmers. However, the organization was phased out between 2010 and 2013, after more than 80 years in existence.[48] David Sauchyn, Professor at the University of Regina, acknowledged that "it would be quite difficult to reconstruct PFRA the way it was."[49] Sauchyn hopes that the federal government will establish an agency with a similar mandate as part of current climate change adaptation initiatives.[50] AAFC explained that the PFRA was established in 1935 under an Act of Parliament to address the drought and soil erosion devastating the Prairies at the time. In 2008, the PFRA's activities were integrated into other departmental programs and services in order to strengthen and more strategically coordinate AAFC's work on environmental issues. These activities are now overseen by the department's Science and Technology Branch. The management of some programs, like the Community Pastures Program, has been transferred to the provinces.[51]

A. Framework Surrounding Federal Climate Change Adaptation Policies

The *United Nations Framework Convention on Climate Change* (UNFCCC) was adopted in 1992 at the Earth Summit in Rio de Janeiro to manage climate change matters at the global level.[52] Under the UNFCCC, Canada has committed to reducing its GHG emissions as part of global efforts to limit the increase in the world's average temperature. While mitigating climate change through GHG emissions reductions, Canada must also adapt to ongoing and expected future climate change.[53]

The national climate change management strategy stems from the UNFCCC. As the federal lead on climate change management, Environment and Climate Change Canada directed the implementation of the 2011 *Federal Adaptation Policy Framework*.[54] This

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47 Ibid., 1635.

48 Ibid.

49 Ibid., 1715.

50 Ibid.

51 Agriculture and Agri-Food Canada, Community Pasture Program.

52 Government of Canada, "*United Nations Framework Convention on Climate Change (UNFCCC)*."

53 2017 Fall Reports of the Commissioner of the Environment and Sustainable Development to the Parliament of Canada, *Report 2—Adapting to the Impacts of Climate Change*.

54 Office of the Auditor General of Canada, *Report 2—Adapting to the Impacts of Climate Change*, 2017.

framework guides the adaptation actions of the federal government and its departments.[55]

In December 2016, the *Pan-Canadian Framework on Clean Growth and Climate Change* was adopted by federal, provincial and territorial (FPT) governments, and Indigenous communities. The purpose of this framework is to fight climate change and improve resilience to it while promoting innovation and clean economic growth. FPT governments committed to working together to implement measures that will reduce GHG emissions and increase carbon sequestration in agricultural soils, including by promoting sustainable management practices. The FPT governments' commitment also involves identifying business opportunities in the agricultural bioeconomy, such as bioproducts and bioenergy.[56]

B. Carbon Pricing

Carbon pricing is the key component of the Pan-Canadian Framework. Under this framework, all provinces and territories must commit to implementing a carbon pricing system by the end of 2018. The federal government plans to impose a carbon pollution pricing system (the "backstop") on jurisdictions that do not develop their own pricing systems or that do not fully meet the benchmark. The goal of this system is to achieve a national target of reducing GHG emissions to 30% below 2005 levels by 2030.[57] At present, Alberta, British Columbia., Ontario and Quebec have implemented carbon pricing systems.[58]

While fuel used for certain agricultural activities is exempt from carbon pricing, some witnesses remain concerned about the carbon pricing system.[59] They fear that carbon pricing will hurt Canada's competitiveness, especially as Canada's main competitors, including the United States, are not imposing such a system, with Australia repealing theirs in 2014.[60] Some witnesses recommended that "primary agriculture and meat and

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55 Government of Canada, *Federal Adaptation Policy Framework*, 12 August 2016.

56 Government of Canada, *Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy*, 2016.

57 Government of Canada, "Pan-Canadian Approach to Pricing Carbon Pollution."

58 Environment and Climate change Canada, *Technical Paper on the Federal Carbon Pricing Backstop*, 2017.

59 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1705 (Jan VanderHout, Member of the Environment Committee, Canadian Horticultural Council).

60 Australian Government, Department of the Environment and Energy, Repealing the Carbon Tax.

food processing be exempt from carbon pricing."[61] Witnesses from the greenhouse sector reminded the Committee that agriculture is an energy-intensive sector, especially in greenhouse production.

> To produce the greenhouse crops that we grow, we need to burn fossil fuels. We cannot do without that in this food production. We also are impacted significantly in our competitiveness because we have the extra cost of carbon pricing—cap and trade or carbon tax—which is a significant problem. We are not asking for an exemption from all carbon tax. We are seeking an exemption only in the fuel we use to grow our crops. Much like the diesel fuel for outdoor agricultural production would be exempt, we would like, in greenhouse production, an exemption from our cost of carbon pricing on natural gas, propane, or heating oil.[62]

Recommendation 4

The Committee recommends that the Government of Canada take into account the realities of the agriculture and agri-food sector when implementing greenhouse gas emissions reduction measures in order to avoid making the sector less competitive.

C. Canadian Agricultural Partnership

The new agricultural policy framework is called the *Canadian Agricultural Partnership* (CAP). Its goal is to strengthen the agriculture and agri-food sector by promoting innovation, growth and prosperity in the sector while protecting the environment, including soil and water, and helping it adapt to climate change. Environmental sustainability and climate change are among the CAP's priorities. The five-year (2018–2023) framework provides for a total of $3 billion in FPT government investment.[63]

> The lion's share of our environment and climate change programs are implemented by the provinces. Although the objectives are the same across the country, the provinces retain some flexibility to address the priorities of farmers in their own regions.[64]

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61 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1635 (Andrea Brocklebank, Executive Director, Beef Cattle Research Council, Canadian Cattlemen's Association).

62 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1700 (Jan VanderHout, Member of the Environment Committee, Canadian Horticultural Council).

63 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1540 (Tom Rosser).

64 Ibid., 1655.

(a) Business risk management

Business risk management (BRM) programs help farmers manage the risks associated with weather conditions, pests and market volatility that can affect the viability of their farm operations.[65]

Farmers can take preventive measures but they are still vulnerable to extreme weather events. For this reason a number of witnesses called for strong BRM programs to help manage and adapt to climate change.[66] Tom Rosser of AAFC explained that the cost-shared programs AgriInsurance and AgriRecovery protect farmers from natural disasters and risks by minimizing their financial impact.[67]

Spending on the AgriInsurance program makes up a large share of the BRM programs' budgetary envelope, accounting for two-thirds of total BRM program expenditures. The AgriRecovery program helps farmers deal with the extraordinary costs of disasters. For example, farmers in Nova Scotia affected by unusually heavy snowfalls in the winter of 2014–2015 received assistance under AgriRecovery. Farmers in B.C. who recently suffered major financial losses owing to wildfires also benefitted from the program.[68]

While AgriRecovery helps farmers cover the extraordinary costs attributable to natural disasters, some witnesses argued that it does not provide enough assistance given the increasing risks associated with climate change.

> AgriRecovery has been delivered in several areas in Canada and has helped producers sustain their business after weather-related disasters. However, there is room for improvement, including the creation of clear triggers and reference materials regarding what the program will and will not cover. Historically, AgriRecovery's dependence on political decision-making during a disaster has compounded confusion in challenging times and has made planning for disasters enigmatic for producers.[69]

Ron Bonnett of the Canadian Federation of Agriculture said that the concept of a disaster may need to be redefined to take into account farmers' realities. He explained that a disaster is not necessarily a one-time event, but rather a series of related events.[70]

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65 Ibid., 1540.

66 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1545 (Doyle Wiebe).

67 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1540 (Tom Rosser).

68 Ibid.

69 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1630 (Andrea Brocklebank).

70 Ibid., 1720 (Ron Bonnett, President, Canadian Federation of Agriculture).

> One of the things we've got to watch is that we don't necessarily always have to look at a disaster as a one-time event, whether it be a massive flood or a fire or something like that; sometimes it's a progression of events. Like I mentioned, this year, in many parts of Ontario, there was so much water I ended up going out and buying a bunch of different equipment so I could store feed that was wet, rather than normal dry hay. Sometimes a disaster is something that goes on gradually and you wouldn't have a disaster declaration. When you're looking at programs, there's a disaster side of it but there's also the investment side.[71]

Besides the BRM programs, the CAP includes science, research and innovation programs. The 2017 federal budget provided for a $200-million investment in natural resources in general, which includes agriculture. This investment supports research into innovative, clean technologies.[72] The budget also allocated $70 million over six years to support "agricultural discovery science and innovation, with a focus on addressing emerging priorities such as climate change and soil and water conservation."[73]

AAFC's Agricultural Greenhouse Gases Program is a $27-million, five-year program that supports research projects seeking ways to reduce net GHG emissions in Canada's agriculture sector.[74]

Research and development activities that relate to climate change are also undertaken by science clusters and the Value Chain Roundtables, which represent various agricultural industries. For example, the Beef Value Chain Roundtable, the Canadian Roundtable for Sustainable Crops and the Dairy Farmers of Canada proAction Initiative are working together to improve sustainability throughout the value chain, including by reducing GHG emissions.[75]

(b) Environmental farm plans

Environmental farm plans were cited a number of times by witnesses as highly effective guides to improving environmental sustainability on farms, through actions such as better manure storage and application and water quality management.[76] Environmental farm plan cost-shared programs support on-farm actions. Assessments are made on the

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71 Ibid.

72 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1600 (Tom Rosser).

73 Ibid., 1545.

74 Ibid., 1530 (Brian Gray).

75 Ibid., 1545 (Tom Rosser).

76 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1535 (Hans Kristensen).

farm to identify and mitigate potential environmental risks.[77] Environmental farm planning is very successful with farmers, as it provides financial incentives to adopt practices that reduce the risks that farmers face, including climate risks.[78]

As mentioned above, environmental management and climate change programs are primarily administered by the provinces and territories. This gives them a certain degree of flexibility: the provinces and territories can tailor the programs to their environmental priorities.[79]

Tony Straathof of the National Farmers Union addressed the environmental farm plans managed by the provinces and territories. He argued that, since the plans vary from province to province, they should be standardized across the country and managed by the federal government.

> It really needs to be. It's really about farmer assessment. Farmers assess their own challenges and problems. If that environmental farm plan is not consistent across all the provinces with an oversight from the federal government—because it covers regions—with participation from the provinces, you're not going to have success, you're not going to implement the programs that you want. We really need to get it national.[80]

Recommendation 5

The Committee recommends that the Government of Canada continue supporting science, research and innovation in order to implement measures that are tailored to the local priorities of the agriculture sector, with the goal of strengthening its environmental sustainability.

IMPACT OF CLIMATE CHANGE ON AGRICULTURE

All the witnesses agreed that extreme climate events will have a major impact on agriculture. Furthermore, many of them observed that the various regions of the country are being affected in different ways. Some regions are experiencing longer periods of drought, while other areas are seeing more flooding. These events result in significant crop losses, which disrupt not only the viability and sustainability of farms,

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77 Ibid.

78 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1540 (Tom Rosser).

79 Ibid.

80 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1725 (Tony Straathof, Board Member, National Farmers Union).

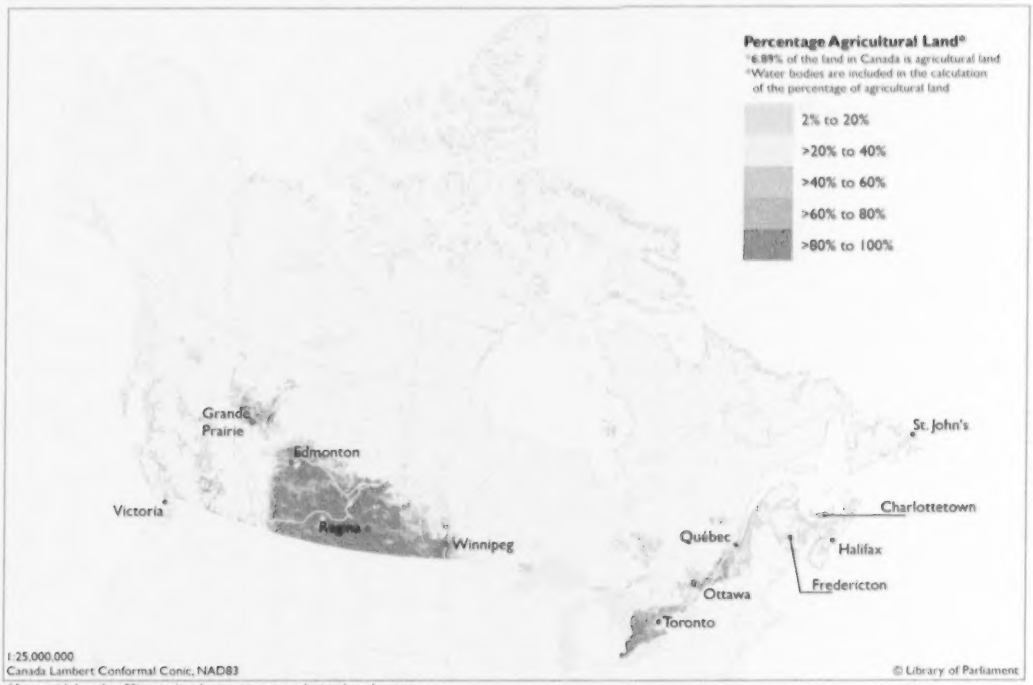
but also the social fabric of entire rural communities. Clearly, climate change is having environmental, economic and even social impacts.

While Canada's total land mass is immense, only 7% of it is used for agriculture.[81] The maps below show the percentage of land used for agriculture within the Soil Landscapes of Canada (SLC) polygons in Canada's agricultural regions (as defined by the 2011 Census of Agriculture). Only areas consisting of more than 2% agricultural land appear on the maps. Note that some bodies of water were included in the calculation of the percentage of agricultural land owing to the original dataset.

Most agricultural activity takes place in the southern prairies of Alberta, Saskatchewan and Manitoba, as well as in southern Ontario between lakes Erie and Huron. The other notable agricultural regions are near Grande Prairie in Western Canada and along the St. Lawrence River in Eastern Canada. The regions home to between 2% and 20% agricultural activity are located primarily in the Maritime provinces and Western Canada, while those with over 80% agricultural activity are mainly found on the Prairies.

81 Agriculture and Agri-Food Canada, *An Overview of the Canadian Agriculture and Agri-Food System 2016*.

Figure 6 – Agricultural Land in Canada, 2013



*Areas with less than 2% agricultural coverage are not depicted on the map

Source: Map prepared by Library of Parliament, Ottawa, 2018, using data from: Agriculture and Agri-Food Canada (AAFC). Agri-Environmental Indicators (AEI). Ottawa: AAFC, 2016; Natural Resources Canada (NRCan). Boundary Polygons. In: Atlas of Canada National Scale Data 1:5,000,000 Series. Ottawa: NRCan, 2013; Natural Resources Canada (NRCan). Place Names. In: Atlas of Canada National Scale Data 1:1,000,000 Series. Ottawa: NRCan, 2014; Natural Resources Canada (NRCan). Waterbodies. In: Atlas of Canada National Scale Data 1:15,000,000 Series. Ottawa: NRCan, 2012; Natural Resources Canada (NRCan). Rivers. In: Atlas of Canada National Scale Data 1:15,000,000 Series. Ottawa: NRCan, 2012; and The World Bank. Agriculture and Rural Development. The World Bank Group, 2017. The following software was used: Esri, ArcGIS, version 10.3.1. Contains information licensed under Open Government Licence – Canada.

Figure 7 – Agricultural Land in Eastern Canada, 2013

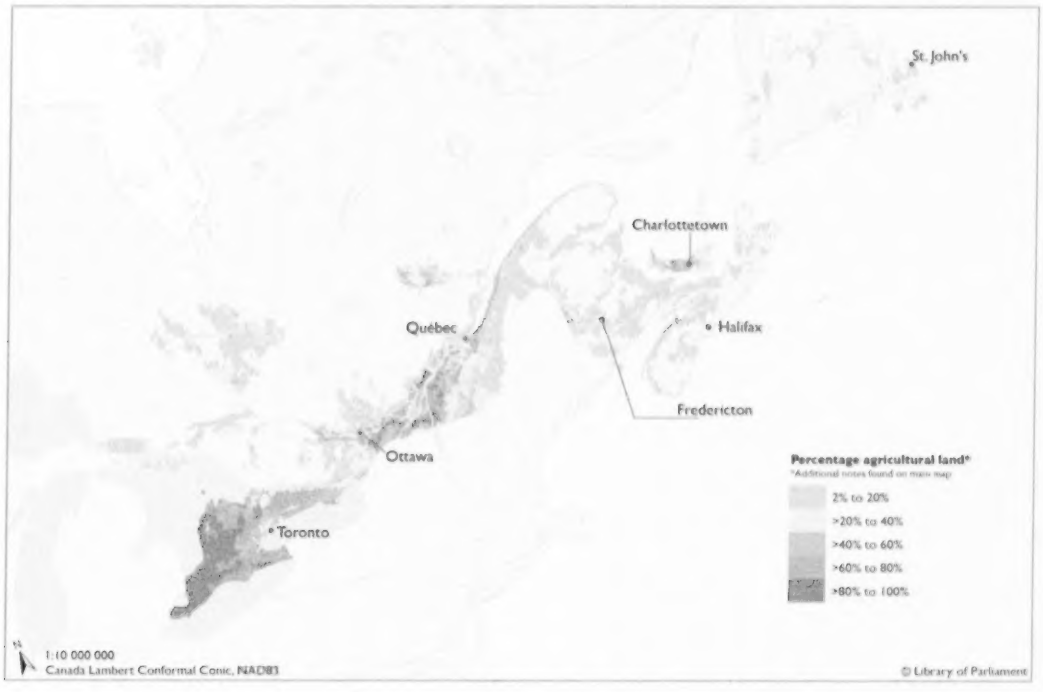
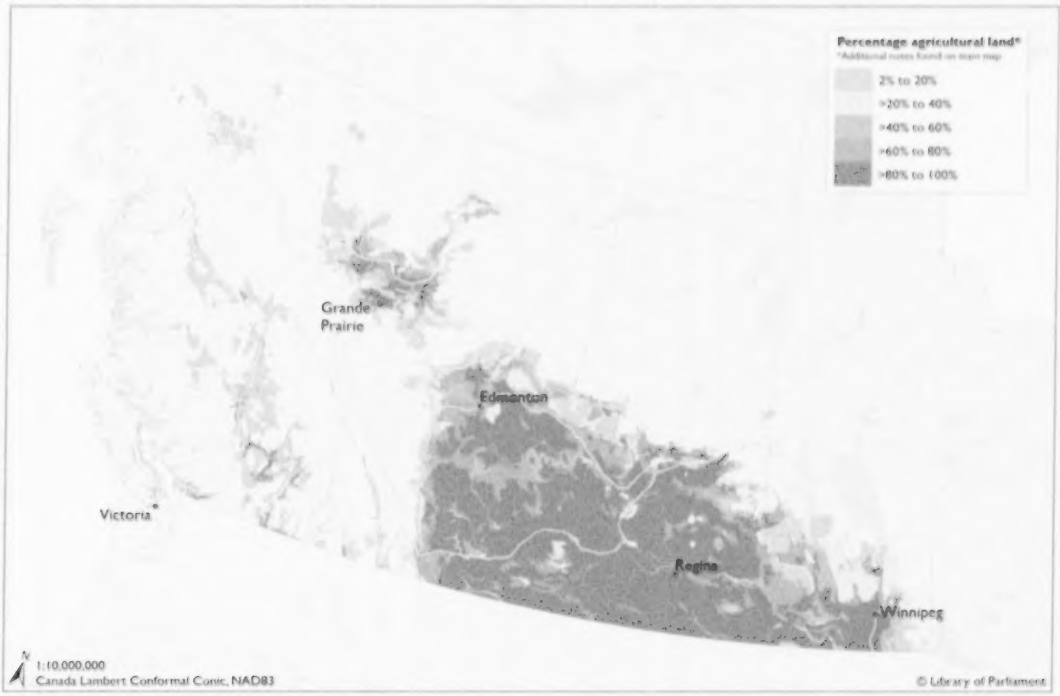


Figure 8 – Agricultural Land in Western Canada, 2013



Dennis Prouse of CropLife Canada believes that climate change presents opportunities to farmers, as growing zones are expanding. Canada could increase its production and meet the rising demand from around the world in the years ahead.[82] However, Alan Kruszel of the Soil Conservation Council of Canada pointed out that "urban sprawl is removing productive land from agriculture."[83]

A number of witnesses expect the warming climate in Canada to extend growing seasons, something that is already happening in several regions of the country. Warming temperatures enable early planting and production of new varieties that could not otherwise be grown. While the prospect of this warming means opportunities for the agriculture sector, it is also sparking concerns and uncertainty. Some witnesses said they expect to see more numerous extreme weather events that could have a devastating impact on crops, including longer droughts and more rainfall, as well as more frequent storms.

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82 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1625 (Dennis Prouse).

83 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1640 (Alan Kruszel).

Some witnesses noted that a warmer climate would not bring only benefits; it would also cause problems. Warming temperatures could encourage the proliferation of weeds and parasites. Warming could also increase the number of invasive insect pests. Andrea Brocklebank from the Canadian Cattlemen's Association said that Canada's cold winters usually prevent parasites from surviving here, so a warmer climate could threaten animal health and welfare.[84] The same is expected to be true for plant pests.

> Canada's cold winters have prevented many parasites and animal diseases from surviving and becoming endemic here. Climate change threatens animal health and welfare, and research has shown that disease-bearing parasites are expanding their ranges.[85]

AAFC officials reported that temperature changes will create suitable conditions for certain plant pests. Figure 9 shows the impact of a 3°C increase on the geographic distribution of three types of pests in Canada. To control these pests, AAFC has identified a number of possible solutions, including developing new varieties of crops that resist them, implementing beneficial management practices and introducing natural predators.[86]

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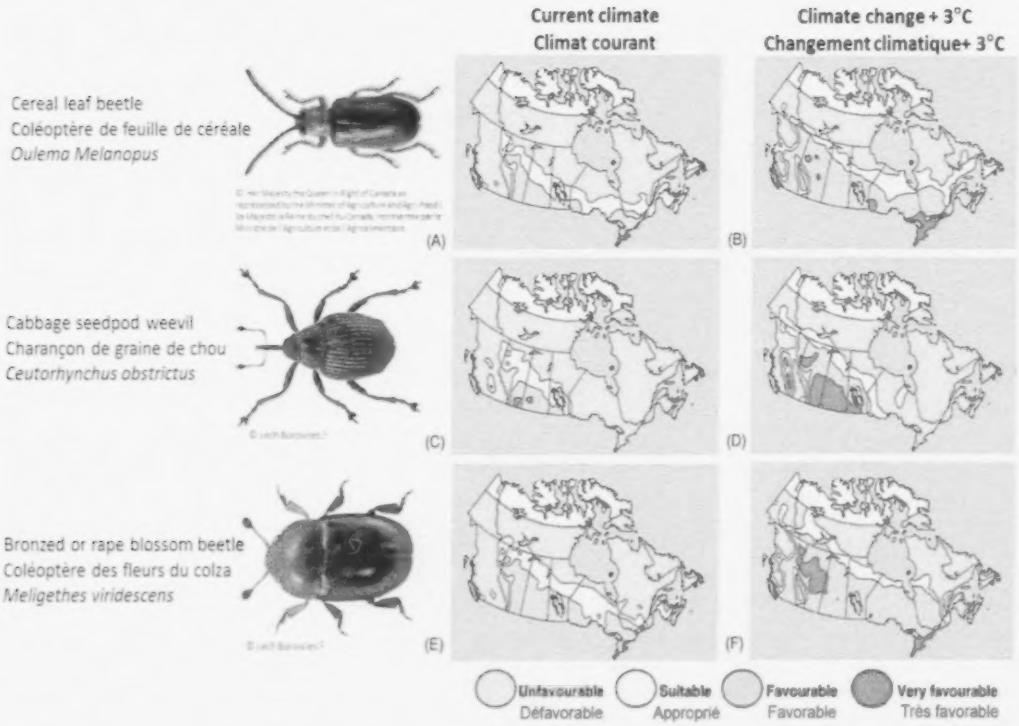
84 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1630 (Andrea Brocklebank).

85 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1630 (Andrea Brocklebank).

86 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1535 (Brian Gray).

Figure 9 – Effects of Climate Change



Sources:

[1] *Ceutorhynchus obstrictus*. http://www.cerisier.org.uk/Coleoptera/Curculionidae/Ceutorhynchus.htm. Reprinted by permission of the publisher/Reproduit avec la permission de l'éditeur.

[2] *Meligethes viridescens*. http://www.cerisier.org.uk/Coleoptera/Meligethes%20viridescens.htm. Reprinted by permission of the publisher/Reproduit avec la permission de l'éditeur.

[3] *Impact of climate change on potential distributions and relative abundances of Oulema melanopus, Meligethes viridescens and Ceutorhynchus obstrictus in Canada*. Agriculture, Ecosystems and Environment 113, 295-301. Reprinted by permission of the publisher/Reproduit avec la permission de l'éditeur.

A number of witnesses emphasized that climate change is affecting pest management, given that warmer winters will no longer provide natural protection against pests.[87] Health Canada's Pest Management Regulatory Agency (PMRA) is currently reassessing the risks associated with the use of the neonicotinoid family of pesticides.[88]

Farmers fear that withdrawing pesticides that are useful in controlling pests could threaten the viability of their businesses if no replacement is available. Furthermore, some witnesses believe that withdrawing these pesticides would lead farmers to use

87 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1655 (Ron Bonnett).

88 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1615 (Doyle Wiebe).

others that are more harmful to the environment.[89] The witnesses told the Committee how important it is for farmers to have access to inspection services and crop protection products, especially in the context of climate change.

> The pesticides now being reviewed would actually increase if they were decertified or taken off the list of products available to me. I would probably have to spray other things that are more harmful to the environment and use up more of my time, fuel, and effort. It would make my job that much more difficult.[90]

Rebecca Lee of the Canadian Horticultural Council suggested that the government should provide enough funding for the inspection and regulatory agencies to function properly to ensure that farmers produce safe, high-quality products.

> Without increased support, these agencies will be limited in their ability to respond rapidly to invasive pests and plant diseases, which in turn jeopardizes the health of our industry and Canada's ability to meet export targets.[91]

Recommendation 6

The Committee recommends that the Government of Canada work with the Pest Management Regulatory Agency and industry to mitigate adverse effects on producers and the environment that may result from banning pesticides without establishing clear alternative solutions.

RESPONSES AND ADAPTATION – CHALLENGES AND OPPORTUNITIES

The agriculture sector is known for being highly adaptable.[92] Producers are used to managing their businesses in the context of changing weather and shifting markets, or as one witness put it, "farmers have to adapt all the time."[93] Adaptation is defined in Canada's Federal Adaptation Policy Framework for climate change as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities."[94]

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89 Ibid., 1545.

90 Ibid.

91 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1630 (Rebecca Lee).

92 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1655 (Ron Bonnett).

93 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1540 (Pierre Desrochers, Associate Professor, Geography Department, University of Toronto).

94 Government of Canada, *Federal Adaptation Policy Framework for climate change*, 12 August 2016.

The federal government recognizes the importance of adaptation, defines its role, and supports the development of adaption solutions through several other policy tools. The Pan-Canadian Framework on Clean Growth and Climate Change points out that "[t]aking action to adapt to current and future climate impacts will help protect Canadians from climate change risks, build resilience, reduce costs, and ensure that society thrives in a changing climate.[95] Natural Resources Canada convenes Canada's Climate Change Adaptation Platform, a national forum founded in 2012, which brings together key groups in Canada to collaborate on climate change adaptation priorities. The Platform Working Groups include one on agriculture, co-chaired by Agriculture and Agri-Food Canada and the Canadian Federation of Agriculture. The Platform "aims to create an enabling environment for adaptation, where decision-makers in regions and industry are equipped with the tools and information they need to adapt to a changing climate."[96]

Producers and the sector are already responding to the impacts of climate change in numerous ways, which are outlined in the sections below.

A. Developing Adapted Crops and Animals

One of the agriculture and agri-food sector's first lines of response to climate change has been the development of improved crops and animals.

Some witnesses pointed out that improving livestock production through the use of genetically superior animals and better breeding techniques, and increasing the feed conversion ratio would reduce GHG emissions. Brian Gray of AAFC explained that the digestive process of cattle produces methane, a major GHG. The department's research in this area has shown that GHG emissions from cattle can be reduced. Furthermore, AAFC has successfully developed lines of beef cattle that emit fewer GHGs.[97]

The witnesses from the pork industry added that nearly half their industry's carbon footprint originates in the process of growing the crops that go into pig feed. If the feed conversion ratio were improved, less crop area would be required to produce that feed. The pork industry is continuing its research into genetics and production methods that will provide feed, water and energy savings.[98]

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95 *Pan-Canadian Framework on Clean Growth and Climate Change*, 2016, p. 27, 31 January 2018.

96 Natural Resources Canada, *Canada's Climate Change Adaptation Platform*, 29 November 2017.

97 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1620 (Brian Gray).

98 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1540 (Hans Kristensen).

Recommendation 7

The Committee recommends that Agriculture and Agri-Food Canada continue to support research into livestock production in order to improve animal genetics and diet with the goal of reducing greenhouse gas emissions.

From drought-tolerant to salt-tolerant crops, a range of new varieties have been developed, through traditional breeding and biotechnology. In addition, through participatory plant breeding, farmers are developing new seed varieties that are locally adapted and perform well in low-input conditions.[99]

Witnesses from Agriculture and Agri-Food Canada described a barley variety that has been developed to withstand up to 10 days of complete inundation.[100] As noted by Doyle Wiebe of Grain Growers of Canada:

> Plant breeding efforts have needed to shift focus to try to address disease and insect issues and other stresses. There has been some success, and we have embraced these solutions whenever possible to improve performance and avoid pesticide applications. As a result, new drought and disease-resistant varieties are having a real, positive impact on the environment.[101]

The representatives of CropLife Canada said that the approval process for new varieties is long, demanding and costly. The timeline for commercializing a new variety can be up to 15 years for varieties developed using biotechnology and nine years for conventional ones.[102] CropLife fears that the slow approval process for new crop varieties is hurting Canada's competitiveness.

According to CropLife, CRISPR (clustered regularly interspaced short palindromic repeats) technology has great potential to deliver results in the coming years.[103] CRISPR is a new, faster and less costly technology that enables plant and animal DNA to be

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99 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1655 (Martin Settle, Executive Director, USC Canada).

100 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1530 (Brian Gray).

101 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1540 (Doyle Wiebe).

102 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1630 (Ian Affleck, Executive Director, Plant Biotechnology, CropLife Canada).

103 Agriculture and Agri-Food Canada, "Sequence analysis of CRISPR arrays of *Erwinia amylovora* isolates from Canada," 2014.

modified with more precision.[104] Still, CropLife acknowledged that "[b]iotechnology in crop protection is not a silver bullet. It's just a set of tools in the farmer's tool box."[105]

Recommendation 8

The Committee recommends that the Government of Canada improve the approval process for new crop varieties in order to help farmers adapt to climate change quickly and seize commercialization opportunities while staying competitive in the market.

B. Applying Best Practices for Sustainable Agriculture

Adapting to current and anticipated impacts of climate change may involve taking measures that increase both the efficiency and the sustainability of production, thus enhancing competitiveness and potentially building trust with consumers. As Hans Kristensen of the Canadian Pork Council explained:

> [t]he necessity of being globally competitive means that we must continually focus on producing more pork while simultaneously utilizing less land, water, and energy. In addition, hog producers are keenly aware of the importance of maintaining the trust of all Canadians, not just those who consume our pork. Our social license is very important to us.[106]

He pointed out:

> If I reduce my water usage, if I improve my feed conversion efficiency, if I reduce my energy footprint, those things are also making me a more efficient producer of my product. I'm producing a greener product, a more efficient product with a greater social licence, and that allows me to compete globally. It is in our own best interests.[107]

In the scientific literature, sustainable agricultural practices and adaptation to climate change are recognized as having similar underlying principles. David Sauchyn noted that "you could argue that if an agriculture producer farms in a sustainable way, they are relatively well prepared for a changing climate."[108] These measures may help build resilience in the long term.

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104 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1555 (Ian Affleck).

105 Ibid., 1600 (Ian Affleck).

106 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1535 (Hans Kristensen).

107 Ibid., 1610.

108 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1700 (David Sauchyn).

Witnesses identified numerous sustainable agricultural practices that producers and industry have adopted to adapt to changing climate conditions, both current and anticipated. Environmental Farm Plans, voluntary assessments supported federally and provincially, were referenced by several witnesses as valuable guides to improved farm environmental sustainability.

Many witnesses recognized building biodiversity as a way to adapt. It was noted that smaller sized farms are typically quite diversified, with healthy soils and robust systems, so they are resilient – if one crop fails, there are others.[109]

Witnesses from the organic sector pointed out that organic agriculture is actually founded on the principles of soil health and resource conservation, and provides many ecosystem services. They indicated that ideas originating in organic agriculture are often adopted later in conventional agriculture. This claim was corroborated by Jan VanderHout of the Canadian Horticultural Council, who agreed that "there is a huge overlap of opportunity for commercial growers to apply those technologies."[110]

In fiscal year 2016–2017, public investment into research and development in the agriculture and agri-food sector was an estimated $557 million.[111] The Committee heard that research in organics receives very little of this funding:

> ... a lot of the great innovation leading us towards more sustainable practices is coming from ecological agriculture, partially through organic agriculture. Yet, when we only invest a quarter of one per cent in R and D for organics, especially when we know the organic sector in Canada is growing at an incredible rate.... It is now maybe only 2.7% of the market, but it's growing rapidly, and whatever comes out of organic research can be applied to all farmers.[112]

Recommendation 9

The Committee recommends that the Government of Canada increase investment in research and innovation in ecological and organic agriculture to better reflect that sector's growing proportion of the market, recognizing that this may yield benefits for agriculture in general.

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109 Ibid., 1650.

110 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1715 (Jan VanderHout).

111 Agriculture and Agri-Food Canada, *An Overview of the Canadian Agriculture and Agri-Food System 2017*.

112 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1710 (Geneviève Grossenbacher, Program Manager, USC Canada).

Another issue for the organic sector is the funding of organic standards. The Government of Canada recently provided $250,000 in funding to the sector for that purpose. Tia Loftsgard of the Canada Organic Trade Association reported that this funding would cover only the administrative costs of the Canadian General Standards Board and that the cost of the last review was $1 million.[113] Moreover, the lack of funding would mean a comprehensive review isn't possible and standards would become outdated and would have to be withdrawn under the Standards Council of Canada requirements. International trade would also be at risk as withdrawn standards would affect the current organic equivalency agreements that Canada has established with countries like the United States, Japan and those the European Union.

Recommendation 10

The Committee recommends that the Government of Canada provide full funding for the Organic Standards review beginning in March 2018.

Clyde Graham, Senior Vice-President of Fertilizer Canada, described the trademarked 4R approach to fertilizer use that helps growers to match fertilizer to their specific conditions and to reduce unnecessary fertilizer application: "the right source of fertilizer and applying it at the right place, at the right time, and at the right rate."[114] The approach has been embraced by several provinces.

Precision farming was presented by several witnesses as an approach that can help farmers save costs and use fewer carbon-intensive resources, thus increasing their efficiency and sustainability overall.[115] It allows farmers to optimize their use of inputs, using highly specific, technical information about soil and the crop being planted, and one day even, as Ian Affleck suggested, perhaps allowing different varieties to be planted in a single field according to the best match of growing conditions with variety.[116]

Several other witnesses presented a slightly different vision, recommending that instead of maximizing production, optimizing it would reduce environmental costs:

> In the past century, the view was that we should maximize crop production, and the way this was done with the green revolution was to maximize inputs: more water and

113 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1650 (Tia Loftsgard, Executive Director, Canada Organic Trade Association).

114 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1530 (Clyde Graham, Senior Vice-President, Fertilizer Canada).

115 Ibid., 1720 (Jason Webster, Vice-Chair, East Prince Agri-Environment Association).

116 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1610 (Ian Affleck).

> fertilizer equals more yield. The problem is that this might not be the optimal use relative to efficiency. Let's imagine that we could cut back on the inputs, but not as strongly cut back on the yield. If we provide lower levels of water and fertilizer and still retain reasonable productivity, this might be a more optimal way to manage our resource. It would also reduce the environmental consequences.[117]

Carbon sequestration mitigates climate change by removing GHGs from the atmosphere. Many of the practices that sequester carbon in the soil are the very same ones that build healthy soil. Offset protocols for carbon sequestration exist in some jurisdictions and may give farmers an additional source of income for providing an ecosystem service. This potential income source is of particular interest to some producers at a time when carbon pricing may be about to have negative financial impacts on their businesses.[118] No till-farming sequesters carbon in the soil, among other environmental benefits.

> There should be recognition of the great good we're doing with that sequestration. It's not trivial. It's millions of tonnes, every year, not just once in time. The minimum tillage practices are the primary driver of that, but also other things too.[119]

Several witnesses pointed out the numerous benefits Canadians may receive from well managed agricultural lands beyond just the food that is produced there – for example, flood control, water quality, carbon storage, biodiversity, and even places for recreation.[120] These benefits may be referred to as ecosystem services, or ecological goods and services.

For example, the valuable role of forage as a buffer for annual crops was described by Cedric MacLeod of the Canadian Forage and Grassland Association, who noted that when water runs off from cropland, it often passes first through a buffer of pastureland and grass, which act as a filter for nutrients.[121]

Naresh Thevathasan describes some of the benefits when trees are planted in an agroforestry approach, for example, noting that this is incentivized by government in the United States but not in Canada:

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117 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1645 (Stewart Rood).

118 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1635 (Kimberly Cornish).

119 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1550 (Doyle Wiebe).

120 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1530 (Elena Bennett, Associate Professor, Natural Resource Sciences).

121 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1620 (Cedric MacLeod, Executive Director, Canadian Forage and Grassland Association).

> What we are trying to do here is to capture the nutrient-cycling aspects, the carbon sequestration aspects, the biodiversity aspects, and the ecosystem services aspects that could be derived, even at a low density of trees in the agricultural systems, in order to reduce runoff, nutrient loading, and enhance bird diversity and microfaunal and macrofaunal diversity.[122]

Recommendation 11

The Committee recommends that the Government of Canada support agroforestry as a way to increase soil carbon sequestration potential for Canada.

C. Reducing Greenhouse Gas Emissions

The Committee heard from many witnesses about their experiences in response to Canada's efforts to meet its international targets on GHG emissions reductions, or climate change mitigation. Many witnesses noted ways in which they or their industry are trying to reduce GHG emissions from their operations as part of their efforts to become more sustainable and efficient. On the positive side, farmers were also able to contemplate future offset credits for their carbon sequestration, from no-till farming, agroforestry, and other approaches. On the other hand, many witnesses were concerned that a price on carbon would likely result in an increase in their costs, which they would not be able to pass on to consumers.

Several witnesses also noted that the anticipated cost increases related to carbon pricing as Canada aims to reduce its GHG emissions will be a challenge for producers, especially greenhouse growers. As noted by Jan VanderHout, "[t]he added costs of these policies, together with the capital intensive infrastructure needed for the construction of greenhouse facilities, make the sector vulnerable to carbon leakage, whereby companies, in an attempt to remain competitive, expand their operations in jurisdictions that aren't subject to carbon pricing."[123]

Recommendation 12

The Committee recommends that the Government of Canada support agricultural producers and processors in Canada by adopting policies and trade agreements that protect our producers and processors from economies that may not have the same environmentally rigorous standards as Canada.

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122 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1600 (Naresh Thevathasan).

123 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1635 (Jan VanderHout).

Recommendation 13

The Committee recommends that climate change efforts be focused on adaptive measures and mitigation efforts, and providing a positive impact to economy, therefore building on Canada's competitive advantages and maintaining competitiveness for Canadian agricultural products.

D. Research and Knowledge Translation

Many witnesses noted how important research has been in supporting adaptation. The Committee heard some examples of highly successful working relationships developed by researchers and farmers. For example, representatives of the East Prince Agri-Environment Association described how, thanks to a liaison person who bridged the gap between government researchers and farmers, the two groups now have a very trusting relationship, and farmers are closely involved in developing new research, "based on exactly what needs to happen in the field."[124]

Recommendation 14

The Committee recommends that the Government of Canada continue to support and allow for extension that complements research activities, in order to help close gaps between researchers and producers.

According to Hans Kristensen, pork producers have benchmarked their industry against producers from other countries and determined that their "carbon footprint is 31% less than the global average."[125] A study of the Canadian beef industry showed a 17% reduction in water use from 1981 to 2011,[126] achieved through a combination of "increased efficiency in animal health and reproduction, improved crop yields, growth weights, slaughter weights, etc."[127] The Canadian Roundtable for Sustainable Crops is working to "develop and measure sustainability metrics for Canadian grain."[128] Efforts to reach these efficiencies benefit producers through cost savings, and help to build trust with consumers. Several witnesses highlighted the potential value of strengthening

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124 House of Commons, *AGRI*, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1725 (Andrea McKenna, Director, East Prince Agri-Environment Association).

125 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1535 (Hans Kristensen).

126 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1710 (Andrea Brocklebank).

127 Ibid.

128 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1540 (Doyle Wiebe).

measurement of ecosystem services. Research and initiatives like these are essential for adapting to climate change.

BUILDING RESILIENCE: ENSURING ADAPTABILITY FOR THE LONG TERM

The dynamic nature of climate change means that adaptation to new challenges may be needed at any time. To be ready for this, Canada's agricultural sector has the capacity to do more than adapt: It can become resilient.

Resilience is characterized in Canada's Federal Adaptation Policy Framework for climate change as "the capacity of people and systems to absorb negative impacts and respond to changing climate conditions."[129] A resilient agricultural system would be able to withstand and adapt to the wide variety of physical, economic, or societal shocks or changes that may be caused by or related to climate change.

As noted earlier, many agricultural producers are already adapting to climate change, and in doing so, are taking measures towards sustainability that will build the long-term resilience of their operations. As stewards of their land, producers are protecting soil, water, biodiversity, and ecosystems. Existing government programs offer various supports, for example, through BRM and support to insurance programs. According to witnesses, however, there is potential for even more strategic changes to be made to help build resilience. The following sections highlight key ideas brought forward by witnesses about ensuring adaptability for the long term.

A. Resilient Agricultural Practices

There was broad agreement among witnesses that healthy soil is essential for successful agriculture in the long term. Witnesses explained the ways in which building healthy soil structure with drainage, organic matter, etc., makes farmland and farming systems increasingly resilient to the impacts of climate change.

Witnesses from a range of sectors agreed on the importance of biodiversity. Martin Settle, Executive Director of USC, referring to on-farm agricultural biodiversity, noted: "That biodiversity is our most precious resource, and it provides the best insurance policy for managing the uncertainty and risk presented by our changing climate."[130] He

129 Environment Canada, Federal Adaptation Policy Framework for climate change, 12 August 2016.

130 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1650 (Martin Settle).

added: "The more diversity of seeds farmers can access and the more diverse traits these seeds have, the better Canada's food supply can adapt to climate stresses."[131]

Not all witnesses agreed on which practices were most sustainable or resilient. Whereas some advocated for precision farming for reducing environmental impact, Elena Bennet pointed out that very technical farming approaches may be less flexible in the face of climate-change-related threats: "If it is more efficient, more tightly controlled, you will be less resilient to shocks, including climate change, including economic change, including anything else that happens suddenly."[132] She cautioned that growers implementing these new technologies must be careful not to create systems that are too rigid.[133]

B. Research and Knowledge Translation

Many witnesses mentioned the need for more accurate information and research to help them understand and meet future adaptation needs. As Ron Bonnett of the Canadian Federation of Agriculture frames it, "[i]n order to maintain resilience, we need a better understanding of the most appropriate adaptive actions relevant to our own operations."[134] Institutional capacity is needed in order to manage and support research, programming, and services that help to "maintain the resilience, viability, and adaptive capacity of rural agricultural communities."[135]

To build greater resilience, witnesses would like to see strengthened knowledge-sharing approaches that build trust and collaboration between researchers and producers, as well as between producers and consumers.

Many witnesses emphasized the importance of recognizing that situations vary dramatically not just across the country but even in different parts of a single farm. This means that solutions must be specific to the areas where they are applied, and there is no one-size-fits-all solution.

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131 Ibid.

132 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 12 December 2017, 1555 (Elena Bennett).

133 Ibid.

134 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1655 (Ron Bonnett).

135 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1635 (David Sauchyn).

Recommendation 15

The Committee recommends that the Government of Canada continue to support sharing of important information related to environmentally sustainable farming practices and adaptation.

C. Incentives for Resilient Agricultural Practices and Ecosystem Services

Witnesses noted that government support, in the form of recognition, extension, or other avenues would be very helpful to promote more resilient agricultural practices.[136] There could also be a role for Environmental Farm Plans.

Tia Loftsgard of the Organic Trade Association suggested that the government "incentivize and reward best environmental and climate-resilient practices,"[137] and several other witnesses expressed similar sentiments.

Many witnesses noted the significant value of the ecosystem services that agricultural landscapes provide, and that many of them will provide to an even greater extent as they become more resilient to climate change impacts. Witnesses agreed that these benefits, which do not generally yield a direct economic benefit to producers, need to be recognized and valued. David Sauchyn sees it as a major constraint to resilience that there is an "expectation in our country, but not elsewhere, that agricultural producers will bear the cost of protecting the ecological goods and services that make our lives possible. They should not be financially disadvantaged for providing this service that benefits all of us."[138]

Recommendation 16

The Committee recommends that the Government of Canada acknowledge the role that producers play as environmental stewards and the innovative ways they are adapting to climate change, as well as their contribution to the public good, in order to strengthen Canadians' understanding and build public trust.

Recommendation 17

The Committee recommends that the Government of Canada encourage new and established farmers to buy into best climate-resilient practices, equipment and

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136 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1535 (Clyde Graham).

137 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 February 2018, 1645 (Tia Loftsgard).

138 Ibid., 1640 (David Sauchyn).

technology that will increase agricultural efficiency, long-term resilience and sustainability.

Recommendation 18

The Committee recommends that the Government of Canada work in collaboration with the provinces and territories to support greater recognition and measurement of ecosystem services.

D. Strong Risk Management

Many witnesses mentioned that strong risk management support was very valuable, but that it must be designed to meet producers' needs. It should be clear in advance who is eligible, and for resilience, eligibility should extend to all types of farming, including low-input and diversified farms.[139]

In addition to solid business risk management programs that will help agricultural businesses survive extreme weather events, several witnesses noted that risk management support for innovation could be very helpful.[140]

Recommendation 19

The Committee recommends that the Government of Canada develop business risk management programs that meet the needs of producers of all scales, including diversified producers, and that the government continue to develop risk management support programs that facilitate producers' innovative efforts to adapt to climate change.

CONCLUSION

Canadian producers have a long history of successful adaptation – including to adverse weather, changing consumer preferences, and increased international competition. As climate change intensifies, continued support from researchers, industry, and government will be instrumental in helping farmers boost their resilience and adapt to the environmental, economic and social challenges. Such challenges include the need to continually increase sustainability, compete in international markets, foster public trust, and comply with new standards and requirements.

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139 Ibid., 1645 (Tia Loftsgard).

140 House of Commons, AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1715 (Alan Kruszel).

APPENDIX A
LIST OF WITNESSES

Organizations and Individuals	Date	Meeting
Canadian Horticultural Council	2017/11/07	77
Rebecca Lee, Executive Director		
Jan VanderHout, Member Environment Committee		
Canadian Roundtable for Sustainable Crops		
Susie Miller, Executive Director		
CropLife Canada		
Ian Affleck, Executive Director Plant Biotechnology		
Dennis Prouse, Vice-President Government Affairs		
Soil Conservation Council of Canada		
Alan Kruszel, Chairman		
USC Canada		
Geneviève Grossenbacher, Program Manager		
Martin Settle, Executive Director		
Department of Agriculture and Agri-Food	2017/11/09	78
Brian T. Gray, Assistant Deputy Minister Science and Technology Branch		
Tom Rosser, Assistant Deputy Minister Strategic Policy Branch		
As individuals	2017/12/07	84
Pierre Desrochers, Associate Professor Geography Department, University of Toronto		
David Sauchyn, Professor Prairie Adaptation Research Collaborative, University of Regina		
Naresh Thevathasan, Associate Professor School of Environmental Sciences, University of Guelph		

Organizations and Individuals	Date	Meeting
University of Lethbridge	2017/12/07	84
Stewart Rood, Professor		
As individuals	2017/12/12	85
Elena Bennett, Associate Professor Natural Resource Sciences		
Sean Smukler, Assistant Professor Junior Chair of Agriculture and Environment of the University of British Columbia		
East Prince Agri-Environment Association		
Gordon McKenna, Board Member		
Andrea McKenna, Manager		
Jason Webster, Vice-Chair		
Research and Development Institute for the Agri-environment		
Aubert Michaud, Soil and Water Conservation Scientist		
Canadian Cattlemen's Association	2018/01/31	86
Andrea Brocklebank, Executive Director Beef Cattle Research Council		
Fawn Jackson, Manager Environment and Sustainability		
Canadian Federation of Agriculture		
Drew Black, Director Environment and Science Policy		
Ron Bonnett, President		
National Farmers Union		
Tony Straathof, Board Member		
Fertilizer Canada	2018/02/05	87
Clyde Graham, Senior Vice-President		
Grain Growers of Canada		
Tyler McCann, Interim Executive Director		
Doyle Wiebe, Director		

Organizations and Individuals	Date	Meeting
Les Fraises de l'Île d'Orléans inc.	2018/02/05	87
Louis Gauthier, General Manager		
Union des cultivateurs franco-ontariens		
Emilia Craiovan, Representative		
Marc Laflèche, Agricultural Producer and Chairman Board of Directors		
Canada Organic Trade Association	2018/02/07	88
Tia Loftsgard, Executive Director		
Tracy Misiewicz, Associate Director Science Programs, The Organic Center		
Canadian Forage and Grassland Association		
Cedric MacLeod, Executive Director		
Canadian Organic Growers		
Avinash Singh, Director		
Kimberly Cornish, Director Food Water Wellness Foundation		
Canadian Pork Council		
Hans Kristensen, 1st Vice-Chair		
Gary Stordy, Director Public and Corporate Affairs		

APPENDIX B
LIST OF BRIEFS

Organizations and Individuals

Canadian Forage and Grassland Association

Canadian Organic Growers

Desrochers, Pierre

Food Water Wellness Foundation

Lynch, Derek

Organic Federation of Canada

Reicosky, Don

Szurmak, Joanna

REQUEST FOR GOVERNMENT RESPONSE

Pursuant to Standing Order 109, the Committee requests that the government table a comprehensive response to this Report.

A copy of the relevant *Minutes of Proceedings* (Meetings Nos. 77, 78, 84, 85, 86, 87, 88, 89, 93, and 94) is tabled.

Respectfully submitted,

Pat Finnigan
Chair

Dissenting Opinion
The Conservative Party of Canada
Climate Change and Soil and Water Conservation

Introduction

We would like to thank the witnesses who appeared before the Standing Committee on Agriculture and Agri-Food for its study on climate change adaptation and water and soil conservation. We agree with the majority of the Committee's report and its recommendations. However, certain aspects of the report should be emphasized and more information must be made available to Canadians in terms of the Liberal government's policies in addressing climate change.

Recognition

A constant theme we heard throughout the Committee's study regarding the current government's approach to climate change policy was a lack of recognition for past efforts made by farmers and ranchers on reducing their environmental footprint. Whether that's through carbon sequestration or capture,[1] frameworks such as the 4R nutrient stewardship,[2] or as a result of research, innovation and increased efficiencies in animal health and reproduction,[3] the results are significant. Therefore, the government's pursuit to penalize greenhouse gas (GHG) emitters through the imposition of a carbon tax without properly recognizing those who have been mitigating and removing GHG's for years or decades, are both short-sighted and inequitable.

The Cost of the Liberal Carbon Tax

Throughout the study it became clear Liberal Members of the committee purposely avoided discussion or inclusion of politically inconvenient facts related to the economic aspects of the government's key component of their Pan-Canadian Framework, the carbon tax. As indicated in the Committee's report, under this framework, the Liberal government will impose a carbon tax on any province or territory whose climate change plan does not meet their approval. As such, we feel it is important for the government to tell Canadians how much of a reduction in greenhouse gas emissions will be achieved with the federal carbon tax and what the cost will be to Canadian farm families.

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[1] AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1550 (Doyle Wiebe, Director, Grain Growers of Canada.

[2] AGRI, *Evidence*, 1st Session, 42nd Parliament, 5 February 2018, 1530 (Clyde Graham, Senior Vice-President, Fertilizer Canada).

[3] AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1635, 1710 (Andrea Brocklebank, Executive Director, Beef Cattle Research Council, Canadian Cattlemen's Association).

We feel it is irresponsible for the government to not fully assess the environmental, economic, employment and fiscal effects of the federal carbon tax and share that information with Canadian farmers and agri-businesses.

At present, Alberta, British Columbia, Ontario and Québec have implemented carbon pricing systems. Recently the Parliamentary Budget Officer (PBO) calculated the total amount of GST collected on carbon pricing in the four provinces to be between $236 million and $267 million in 2017-18 and between $256 million and $313 million in 2018-19.[4] The PBO's report clearly shows, contrary to the federal government's claim, the carbon tax is not revenue-neutral and will yield federal financial benefits.

Agriculture and Agri-Food officials were able to confirm to the Committee a preliminary analysis of a $50-per-tonne carbon tax would cost farmers in Western Canada, on average, $3,705 a year and farmers in Eastern Canada $2,423.[5] In an internal memo to the Agriculture Minister which contained the analysis, it indicated a $50-per-tonne carbon tax was too low to achieve the target of a 2 per cent reduction of agricultural GHG emissions and a $100-per-tonne carbon tax was needed instead.[6]

Furthermore, in the April 2018 Economic and Fiscal Outlook, the PBO reported the carbon tax will reduce Canada's GDP by $10 billion per year by 2022.[7]

With a focus on agriculture, the PBO also completed an analysis of what the cost of a $25-per-tonne carbon tax would be for Canadian farms (Table 1, Table 2 and Table 3).[8]

As we can see these are not insignificant costs and they will compromise the competitiveness of our farmers, ranchers and processors who have, for years, demonstrated an ability to deliver meaningful reductions in emissions through the adoption of new technologies, education and innovative management practice. For example, Dennis Prouse of CropLife Canada highlighted through the use of plant science technologies, farmers have reduced greenhouse gas emissions by 29 million tonnes per year and lowered diesel fuel use by up to 194 million litres per year.[9]

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[4] *Cost of Carbon tax deduction from GST*, 12 December 2017, Office of the Parliamentary Budget Officer.

[5] AGRI, *Evidence*, 1st Session, 42nd Parliament, 9 November 2017, 1625 (Tom Rosser, Assistant Deputy Minister, Strategic Policy Branch, AAFC) and letter to the clerk of the Standing Committee on Agriculture and Agri-Food from AAFC on 22 December 2017.

[6] Letter to the clerk of the Standing Committee on Agriculture and Agri-Food from AAFC on 22 December 2017 and access to information request A-2017-00037 (AAFC), June 2017.

[7] *Economic and Fiscal Outlook – April 2018*, 23 April 2018, Office of the Parliamentary Budget Officer.

[8] Brief to the Standing Committee of Agriculture and Forestry on 29 November 2017.

[9] AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1535 (Dennis Prouse, Vice-President, Government Affairs, CropLife Canada).

Table 1. Cattle farms and swine

	Cattle							Swine
	Average farm size[1]		Emissions per farm (tCO2e)		Cost per farm[2]		Total cattle and calves (1000)	Cost per farm[3]
	non-Dairy	Dairy	non-Dairy	Dairy	non-Dairy	Dairy		
Alberta	94	97	173	463	$4,330	$11,566	5,207	$3,864
British Columbia	63	110	116	529	$2,902	$13,215	659	$315
Manitoba	77	98	140	469	$3,510	$11,724	1,103	$16,279
New Brunswick	26	79	48	380	$1,201	$9,507	68	$1,536
Newfoundland	7	156	13	746	$333	$18,654	10	$542
Nova Scotia	23	81	41	386	$1,035	$9,651	76	$363
Ontario	26	71	47	339	$1,171	$8,486	1,624	$4,098
Prince Edward Island	30	70	55	335	$1,385	$8,375	59	$3,001
Quebec	41	62	75	298	$1,877	$7,446	1,132	$7,411
Saskatchewan	89	94	163	449	$4,080	$11,217	2,592	$4,952
Canada	**71**	**73**	**131**	**349**	**$3,271**	**$8,716**	**12,531**	**$5,367**

Source: Agriculture Census (2016), National Inventory Report (2017).
Note: These numbers are approximate since they combine agriculture census data for 2016 with emission data for 2015. Nonetheless, alternative data sources suggest that Canada's cattle population was virtually unchanged between 2015 and 2016, while the hogs population increased by 3.6%. So the cost per swine farm could be 3 to 4 % higher.
(1) Includes all cattle (steers, heifers and cows), calves, and bulls.
(2) Using an average lifespan of cattle of 1.5 years, a $25 carbon tax adds $69 for a beef cow, and $180 for a dairy cow.
(3) A $25 carbon tax adds $3.2 for each swine based on standard "Canada-wide" average manure treatment.

Table 2. Croplands

	Average seeded farm area (acres)	Average emissions (ktCO2e)	Average cost per farm	Emissions per acre (tCO2e)		
				Total	*of which, from inorganic fertiliser*	*of which, from crop residue*
Alberta	855	6,800	$6,631	0.31	*0.13*	*0.07*
British Columbia	93	450	$1,685	0.72	*0.14*	*0.08*
Manitoba	995	3,300	$7,966	0.32	*0.17*	*0.07*
New Brunswick	153	270	$6,472	1.70	*0.28*	*0.20*
Newfoundland	24	32	$4,211	7.13	*0.28*	*0.24*
Nova Scotia	72	130	$2,664	1.48	*0.28*	*0.16*
Ontario	210	4,200	$2,921	0.56	*0.12*	*0.14*
Prince Edward Island	323	193	$5,403	0.67	*0.28*	*0.19*
Quebec	187	3,500	$5,230	1.12	*0.21*	*0.21*
Saskatchewan	1375	6,800	$6,224	0.18	*0.12*	*0.04*
Canada	648	**25,675**	$5,094	0.31	*0.13*	*0.07*

Source: Agriculture Census (2016), National Inventory Report (2017).

Note: These numbers are approximate since they combine agriculture data for 2016 with emission data for 2015. Since Canada's croplands declined by 0.9% between the 2011 and 2016 census, the 2015 measure of croplands is approx. 0.18% less than 2016. The approximation should thus only have small errors that are unlikely to affect any conclusions. The conversion of product per acre (Annex Table 1-1) to crop residue was done using Janzen, et al (2003). For the columns outlining inorganic fertiliser (column 6) and crop residue (column 7), the calculation is done on the basis that all crops use nitrogen fertiliser and leave a crop-specific residue. Emissions would be adjusted for farms that don't use inorganic fertilizer and/or remove crop residue.

Table 3. Cost of on-farm energy and transport emissions ($25 per tCO2e tax)

	Alberta	British Columbia	Manitoba	New Brunswick	Newfoundland	Nova Scotia	Ontario	Prince Edward Island	Quebec	Saskatchewan	Canada
Average cost per farm	$2,030	$856	$1,690	$1,109	$909	$719	$1,300	$820	$951	$3,693	$1,801

Source: Agriculture Census (2016), National Inventory Report (2017).
Note: These numbers are approximate since they combine agriculture data for 2016 with emission data for 2015. Since Canada's farms declined by 6% between 2011 and 2016, the results reported in the table are likely understated by 1% to 1.5%.

Competitiveness

Against the backdrop of rising global trade protectionism, government measures which erode Canada's competitiveness and comparative advantages in agriculture will ensure the failure in achieving its goal of growing agri-food exports to $75 billion annually by 2025.[10] That is why many witnesses view the federal carbon tax as a disadvantage[11] [12] [13] [14] [15] which increases the cost of operations in Canada, while competitors in other countries face no such penalty.

Conclusion

We believe our agriculture sector has, and will continue to, contribute to Canada's climate change objectives. We must recognize the sector's past efforts and ongoing commitments to climate change, soil and water conservation. However, we must aim to improve the competitiveness of Canadian agriculture.

As a result of damaging policies such as the carbon tax and inaction on issues like the grain backlog, the Liberal government has lost the confidence of the agriculture and agri-food stakeholders. They must reverse damaging policies to regain the lost confidence and trust.

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[10] Budget 2017, Growing the Economy Through Agri-Food Innovation, p. 107.
[11] AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 November 2017, 1635, 1700 (Jan VanderHout, Member of the Environment Committee, Canadian Horticultural Council).
[12] AGRI, *Evidence*, 1st Session, 42nd Parliament, 7 December 2017, 1555, 1620 (Dr. Pierre Desrochers, Associate Professor, Geography Department, University of Toronto).
[13] AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1700 (Tony Staathof, Board Member, National Farmers Union).
[14] AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1630 (Andrea Brocklebank, Executive Director, Beef Cattle Research Council, Canadian Cattlemen's Association).
[15] AGRI, *Evidence*, 1st Session, 42nd Parliament, 31 January 2018, 1645 (Fawn Jackson, Manager, Environment and Sustainability, Canadian Cattlemen's Association).

Recommendation

That the Government of Canada abandon the federal carbon tax which disproportionately harms the agriculture sector and rural communities.